Maintain reliable transmission network services at Loy Yang and Hazelwood terminal stations

Project Specification Consultation Report

Regulatory Investment Test - Transmission

July 2021

missionzero

AusNet services

Important notice

Purpose

AusNet Services has prepared this document to provide information about potential limitations in the Victoria transmission network and options that could address these limitations.

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Executive summary

AusNet Services is initiating this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain reliable transmission network services at Loy Yang (LYPS) and Hazelwood (HWTS) terminal stations. Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER)[1] and section 4.2 of the RIT-T Application Guidelines[2].

Loy Yang and Hazelwood terminal stations are owned and operated by AusNet Services and are located in the Latrobe Valley. These two terminal stations were commissioned in the 1970s and 1980s and form part of the main Victorian 500 kV transmission system.

Identified need

As expected of assets that have been in service for a long time, the condition of the 500 kV switchgear have deteriorated to a level where there is a material risk of asset failure, which could have an impact on electricity supply reliability, generation cost, safety, environment, collateral damage and potential costs of emergency replacements. The 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at LYPS and HWTS, which form part of the main transmission network backbone and mitigate risks from asset failures.

The present value of the baseline risk costs to maintain the existing assets in service is more than $63 million. The key components of the baseline risk are the impact on the market (generation and electricity consumers) and the emergency asset replacement cost of an asset failure. AusNet Services is therefore investigating options that could allow continued delivery of safe and reliable transmission network services to users of the main transmission network.

Credible options

AusNet Services estimates that network or non-network investments are likely to deliver more economical and reliable solutions compared with keeping the existing assets in service and identified the following credible network solutions that could meet the identified need:

- Option 1 – Replace by 2028/29
- Option 2 – Replace by 2031/32

AusNet Services welcomes proposals from proponents of non-network options (stand-alone or in conjunction with a network solution), that meet the identified need, such as:

- options that allow for the retirement or deferral of switchgear replacements at LYPS and HWTS by providing local supply or demand curtailment of sufficient scale.

Assessment approach

AusNet Services will investigate the costs, the economic benefits, and the ranking of options in this RIT-T assessment. The robustness of the ranking and optimal timing of options will be investigated through:

- the use of three scenarios that are consistent with the Australian Energy Market Operator's (AEMO) *2021 Draft Inputs, Assumptions and Scenarios report (IASR)*: Slow Growth, Central, and Sustainable Growth; and
- sensitivity analysis that involves variation of assumptions around the values used for the Central Scenario.

[1] Australian Energy Market Commission, *"National Electricity Rule version 168"*
[2] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission,"*

Options assessment and draft conclusion

AusNet Services' cost-benefit assessment confirms that Option 1 is the most economic option as it provides the highest present value of net economic benefits. This option will not only maintain supply reliability, but also mitigates safety, environmental, and emergency asset replacement risk costs.

The optimal timing of the preferred option is to complete the project by 2028/29.

The robustness of this RIT-T has been tested by a sensitivity analysis, which concluded that the preferred option has the highest net present benefit of all options for all sensitivities studied. Therefore, AusNet Services concludes that delivery of Option 1 by 2028/29 is the most economical and thus the preferred option to address the identified need.

Submissions

AusNet Services welcomes written submissions on the topics and the credible options presented in this PSCR and invites proposals from proponents of potential non-network options.

Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before November 2024. In the subject field, please reference 'RIT-T PSCR LYPS and HWTS.'

Next steps

Assessments of the options and responses to this PSCR will be presented in the Project Assessment Draft Report (PADR) that is intended to be published before July 2025.

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1. Introduction

AusNet Services is initiating this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain reliable transmission network services at Loy Yang Power Station (LYPS) and Hazelwood Terminal Station (HWTS) in response to the deterioration of assets at these two terminal stations.

Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process[3] in accordance with clause 5.16 of the National Electricity Rules (NER)[4] and section 4.2 of the RIT-T Application Guidelines.[5]

This document describes:

- the identified need that AusNet Services is seeking to address, together with the assumptions used in identifying this need;
- credible network options that may address the identified need;
- the technical characteristics that would be required of a non-network option to address the identified need;
- the assessment approach and scenarios AusNet Services is intending to employ for this RIT-T assessment; and
- the specific categories of market benefits that are unlikely to be material in this RIT-T.

The need for investment to address risks from the deteriorating assets is presented in AusNet Services Asset Renewal Plan that is published as part of AEMO's 2020 Victorian Transmission Annual Planning Report (VAPR)[6].

[3] A RIT-T process will assess the economic efficiency and technical feasibility of proposed network and non-network options
[4] Australian Energy Market Commission, *"National Electricity Rule version 168"*
[5] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission"*
[6] Australian Energy Market Operator, *"Victorian Annual Planning Report"*

2. Identified need

The role of LYPS and HWTS in providing electricity network services and the condition of key assets are discussed below. Quantification of the risk costs associated with the deterioration of these assets and the need for the investments are also presented.

2.1. Transmission network services at LYPS and HWTS

LYPS and HWTS are owned and operated by AusNet Services and are located in the Latrobe Valley (LV). These two terminal stations are part of the main 500 kV transmission network, which provides major transmission network services in Victoria. The 500 kV transmission backbone runs from east to west across the state and connects generation in the Latrobe Valley and western parts of Victoria with the major load center in Melbourne. It also forms an interconnector with South Australia at Heywood Terminal Station (HYTS) as shown blow.

Figure 1 - 500 kV Transmission Network Backbone

LYPS and HWTS serve as 500 kV switching stations located in the Latrobe Valley as shown in Figure 2.

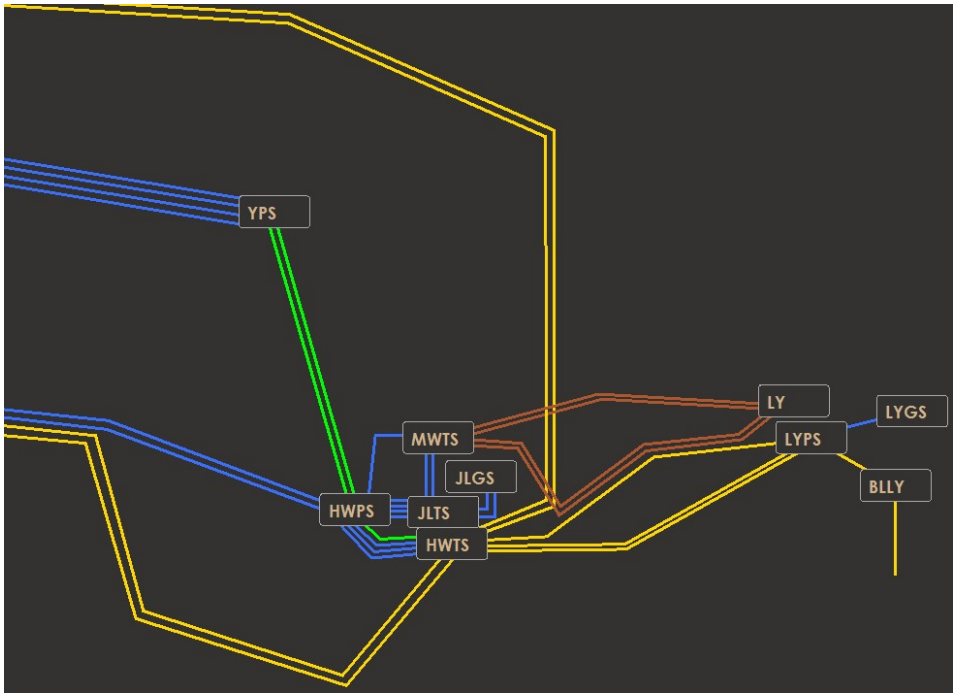

Figure 2 - Latrobe Valley Transmission Network

2.2. Asset condition

The condition of some of the assets are in a poor condition and the mean time to restore the transmission service following an asset failure is expected to be very long, especially when faced with multiple failures.

AusNet Services classifies asset condition using scores that range from C1 (initial service condition) to C5 (very poor) – as set out in Appendix C. The probability of asset failure is high and is likely to increase further if no remedial action is taken. Table 1 provides a summary of the condition of the assets at LYPS and HWTS.

Asset class	Condition scores				
	C1	C2	C3	C4	C5
LYPS 500 kV Circuit Breakers	5	2	0	4	8
HWTS 500 kV Circuit Breakers	0	5	3	4	3

Table 1 - Summary of major equipment condition scores

2.3. Description of the identified need

LYPS and HWTS are part of the main Victorian 500 kV transmission network, which provides major transmission network services in Victoria. AusNet Services expects that the services that these two terminal stations provide will continue to be required given the transmission network developments that are foreshadowed in AEMO network plans for Victoria.

Without remedial action, other than ongoing maintenance practice (business-as-usual), the assets are expected to deteriorate further and more rapidly. This will increase the probability of asset failure, resulting in a higher likelihood of an impact on users of the transmission network, heightened safety risks due to potential explosive failure of the assets, environmental risks, collateral damage risks, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs. Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at LYPS and HWTS and to mitigate risks from asset failures.

The present value of the baseline risk costs is more than $63 million over the forty-five year period from 2021/2022. The key risk elements are shown in Figure 3, with the largest component of the baseline risk being the monetized market impact from potential asset failures and the associated emergency asset replacement risk cost.

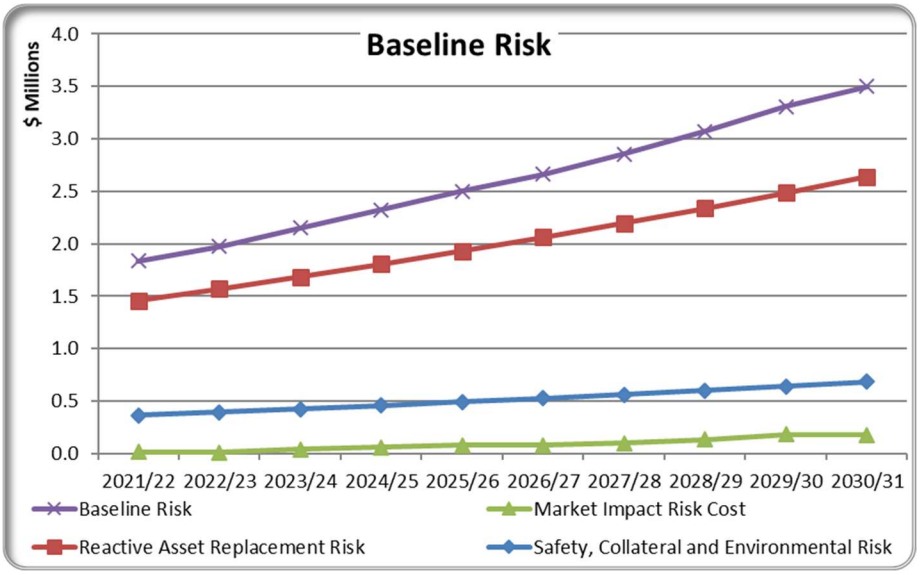

Figure 3 - Baseline risk costs

By delivering the options identified in this RIT-T, AusNet Services will be able to maintain reliable transmission network services and mitigate safety and environmental risks, as required by the NER and Electricity Safety Act 1998[7].

2.3.1. Assumptions

Aside from the failure rates (determined by the condition of the assets), AusNet Services also adopted the following assumptions to quantify the risks associated with asset failure.

Market impact costs

AusNet Services calculated the market impact cost, which consist of increased generation cost and expected unserved energy of an asset failure based on the latest Value of Customer Reliability (VCR).

Safety risk costs

The Electricity Safety Act 1998[8] requires AusNet Services to design, construct, operate, maintain, and decommission its network to minimize hazards and risks to the safety of any person as far as reasonably practicable or until the costs become disproportionate to the benefits from managing those risks. By implementing this principle for assessing safety risks from explosive asset failures, AusNet Services uses:

- a value of statistical life[9] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[10]; and

[7] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Energy Safe Act 1998,"* available at http://www.legislation.vic.gov.au/domino/Web_Notes/LDMS/LTObject_Store/ltobjst9.nsf/DDE300B846EED9C7CA257616000A3571/1D9C11F63DEBA5E2CA257E70001687F4/%24FILE/98-25aa071%20authorised.pdf

[8] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Energy Safe Act 1998,"* available at http://www.legislation.vic.gov.au/domino/Web_Notes/LDMS/LTObject_Store/ltobjst9.nsf/DDE300B846EED9C7CA257616000A3571/1D9C11F63DEBA5E2CA257E70001687F4/%24FILE/98-25aa071%20authorised.pdf

[9] Department of the Prime Minister and Cabinet, Australian Government, *"Best Practice Regulation Guidance Note: Value of statistical life,"* available at https://www.pmc.gov.au/resource-centre/regulation/best-practice-regulation-guidance-note-value-statistical-life

[10] Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13," available at https://www.safeworkaustralia.gov.au/system/files/documents/1702/cost-of-work-related-injury-and-disease-2012-13.docx.pdf

- a disproportionality factor[11].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the practice notes[12] provided by the AER.

Financial risk costs

As there is a lasting need for the services, the failure rate weighted cost of replacing failed assets (or undertaking reactive maintenance) is included in the assessment.[13]

Environmental risk costs

Environmental risks from plant that contains large volumes of oil or SF6, which may be released in an event of asset failure, is valued at $100,000 per event.

[11] Health and Safety Executive's submission to the1987 Sizewell B Inquiry suggesting that a factor of up to 3 (i.e. costs three times larger than benefits) would apply for risks to workers; for low risks to members of the public a factor of 2, for high risks a factor of 10. The Sizewell B Inquiry was public inquiry conducted between January 1983 and March 1985 into a proposal to construct a nuclear power station in the UK.

[12] Australian Energy Regulator, *"Industry practice application note for asset replacement planning"*

[13] The assets are assumed to have survived and their condition-based age increases throughout the analysis period

3. Credible network options

AusNet Services will consider both network and non-network options to address the identified need caused by the deteriorating assets at LYPS and HWTS. The network options AusNet Services has identified are presented below and the technical requirements that a non-network option would have to provide are detailed in the next chapter.

3.1. Option 1 – Replace by 2028/29

Option 1 involves replacement of the 500 kV assets with a high probability of failure during the 2022 to 2027 TRR period and for the project to be completed by 2028/29. The estimated capital cost of this option is $60.2 million with no material change in operating and maintenance cost.

3.2. Option 2 – Replace by 2031/32

Option 2 involves replacement of the 500 kV assets with a high probability of failure after the 2022 to 2027 TRR period and for the project to be completed by 2031/32. The estimated capital cost of this option is $60.2 million with no material change in operating and maintenance cost.

3.3. Material inter-regional network impact

The proposed asset replacement at LYPS and HWTS will not change the transmission network configuration and none of the network options considered are likely to have a material inter-regional network impact. A 'material inter- regional network impact' is defined in the NER as:

> *"A material impact on another Transmission Network Service Provider's network, which may include (without limitation): (a) the imposition of power transfer constraints within another Transmission Network Service Provider's network; or (b) an adverse impact on the quality of supply in another Transmission Network Service Provider's network."*

4. Non-network options

AusNet Services welcomes proposals from proponents of non-network options that could be implemented on a stand-alone basis or in conjunction with a network option to meet or contribute to meeting the identified need for this RIT-T. AusNet Services will evaluate identified non-network options based on their economic and technical feasibility, but considers that it is unlikely that non-network solutions will be technically feasible solutions given that LYPS and HWTS are part of the main transmission extra high voltage backbone.

Proposals for non-network solutions should be emailed to rittconsultations@ausnetservices.com.au by November 2024. In the subject field, please reference 'RIT-T PSCR LYPS and HWTS.'

Submissions will be published on AusNet Services' and AEMO's websites. If you do not wish for your submission to be made public, please clearly stipulate this at the time of lodgment.

5. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology[14], AusNet Services will undertake a cost-benefit analysis to evaluate and rank the net economic benefits of all credible options. AusNet Services proposes to undertake this assessment over a 45-year period.

All options considered will be assessed against a business-as-usual case where no proactive capital investment to reduce the increasing baseline risks is made. Optimal timing of an investment option will be the year when the annual benefits from implementing the option become greater than the annualised investment costs.

5.1. Input assumptions and sensitivity studies

The robustness of the investment decision and the optimal timing of the preferred option will be tested by a sensitivity analysis. This analysis involves variation of assumptions from those employed under the base case.

Parameter	Lower Bound	Base Case	Higher Bound
Asset failure rate	AusNet Services assessment – 25%	AusNet Services assessment	AusNet Services assessment + 25%
Demand Growth	Low Growth	AEMO Forecast	High Growth
Value of customer reliability	Latest AER VCR figures - 25%	Latest AER VCR figures	Latest AER VCR figures + 25%
Discount rate	2.58% - regulated cost of capital	4.8% - commercial discount rate	7.02% - symmetrical adjustment upwards

Table 2 - Input assumptions used for the sensitivity studies

5.2. Material classes of market benefits

NER clause 5.16.1(c)(4) formally sets out the classes of market benefits that must be considered in a RIT-T. AusNet Services estimates that the classes of market benefits that are likely to be material include changes in involuntary load shedding, and changes in fuel cost arising through different patterns of generation dispatch. AusNet Services' proposed approach to assess these classes of market benefits is set out in section 2.3.

5.3. Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects material reduction in: safety risks from potential explosive failure of deteriorated assets, environmental risks from possible oil spillage, collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs by implementing any of the options considered in this RIT-T.

5.4. Classes of market benefits that are not material

AusNet Services estimates that the following classes of market benefits are unlikely to be material for any of the options considered in this RIT-T:

- Changes in costs for parties, other than the RIT-T proponent – there is no other known

[14] Australian Energy Regulator, *"Industry practice application note for asset replacement planning"*

investment, either generation or transmission, that will be affected by any option considered.

- Changes in ancillary services costs – the options are not expected to impact on the demand for and supply of ancillary services.
- Competition benefits – there is no competing generation affected by the limitations and risks being addressed by the options considered for this RIT-T.
- Option value – as the need for and timing of the investment options are driven by asset deterioration, there is no need to incorporate flexibility in response to uncertainty around any other factor.

6. Options assessment

This section details the analysis of the costs and benefits from the network options considered in this RIT-T. Any credible option that may arise from submissions in response to this PSCR will be assessed and presented as part of the next step of this RIT-T.

All the options considered in this RIT-T will deliver a reduction in supply risk, safety risk, environmental risk, collateral risk and risk cost of emergency replacement if the asset failed.

6.1. Sensitivity analysis

This section describes the sensitivity of the net economic benefits, ranking of options, and optimal timing of the preferred option to different assumptions of key variables.

Sensitivity of net economic benefits

Using the base case (BC) as the reference, the net economic benefits from implementing an option changes for different assumptions of key variables. The net economic benefits are positive for most sensitivities studied for Option 1 (Replace by 2028/29) and Option 1 has the highest net benefits for most sensitivities tested, as shown in Figure 4. Option 1 is thus the most economical investment option.

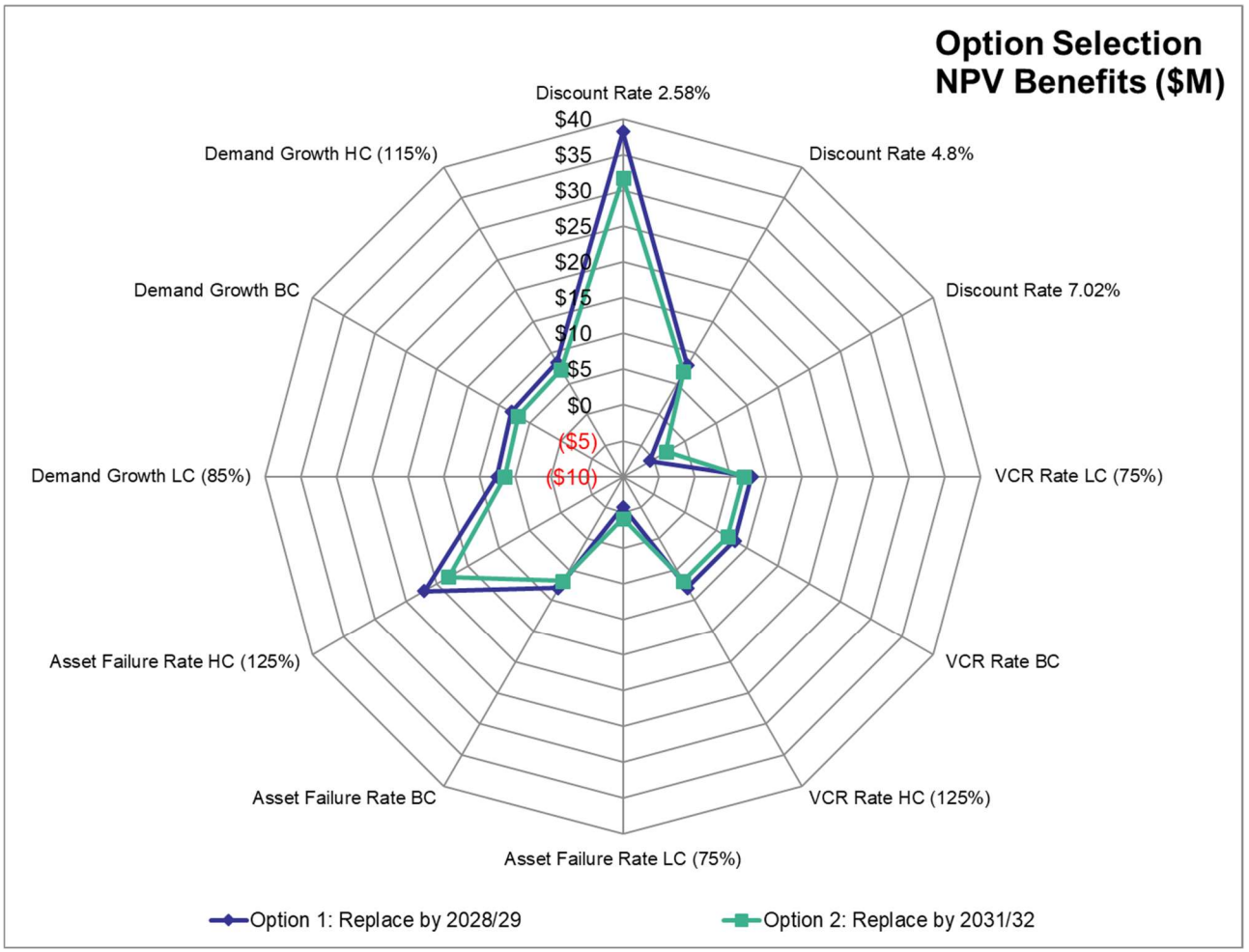

Figure 4 - Sensitivity of net economic benefits with respect to variation of key parameters

Sensitivity of optimal timing

Figure 5 shows that the optimal timing of the preferred option is 2028/29 and that the investment is needed within the 2022 to 2027 regulatory control period.

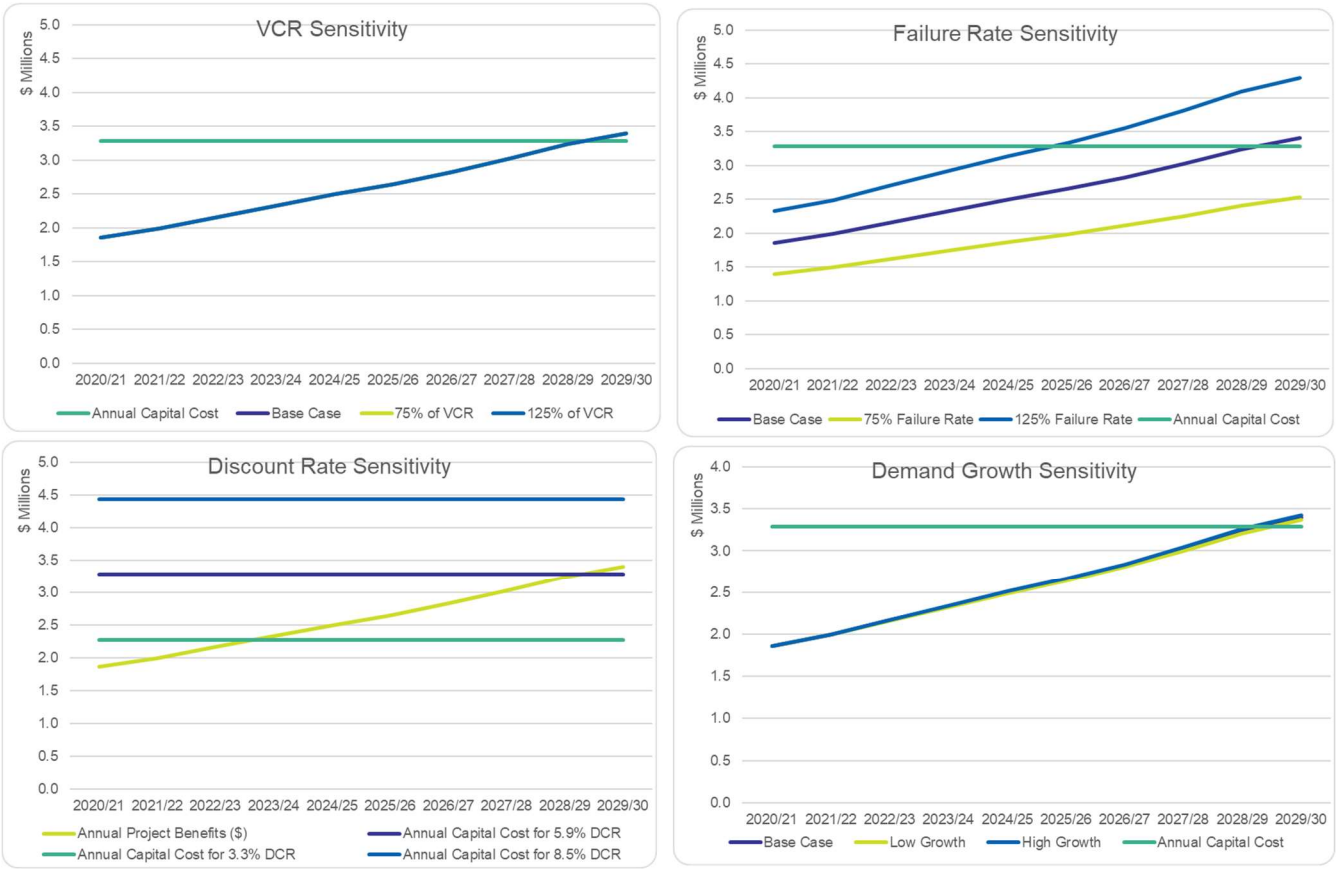

Figure 5 - Sensitivity of the optimal timing with respect to variation of key parameters

7. Draft conclusion and next steps

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain reliable transmission network services at LYPS and HWTS and manage safety, environmental and emergency replacement risks. The preferred option involves the following scope of work in a single integrated project:

- Replacement of seven 500 kV circuit breakers at HWTS and twelve 500 kV circuit breakers at LYPS
- Replacement of one set of 500 kV current transformers at HWTS and nine sets of 500 kV current transformers at LYPS
- Replacement of three sets of 500 kV voltage transformers HWPS and two sets of 500 kV voltage transformers LYPS

The estimated capital cost of this option is $60.2 million with no material change in operating cost. The project is economic by 2028/29.

Submissions

AusNet Services welcomes written submissions on the topics and the credible options presented in this PSCR and invites proposals from proponents of potential non-network options.

Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before November 2024. In the subject field, please reference 'RIT-T PSCR LYPS and HWTS.'

Appendix A - RIT-T assessment and consultation process

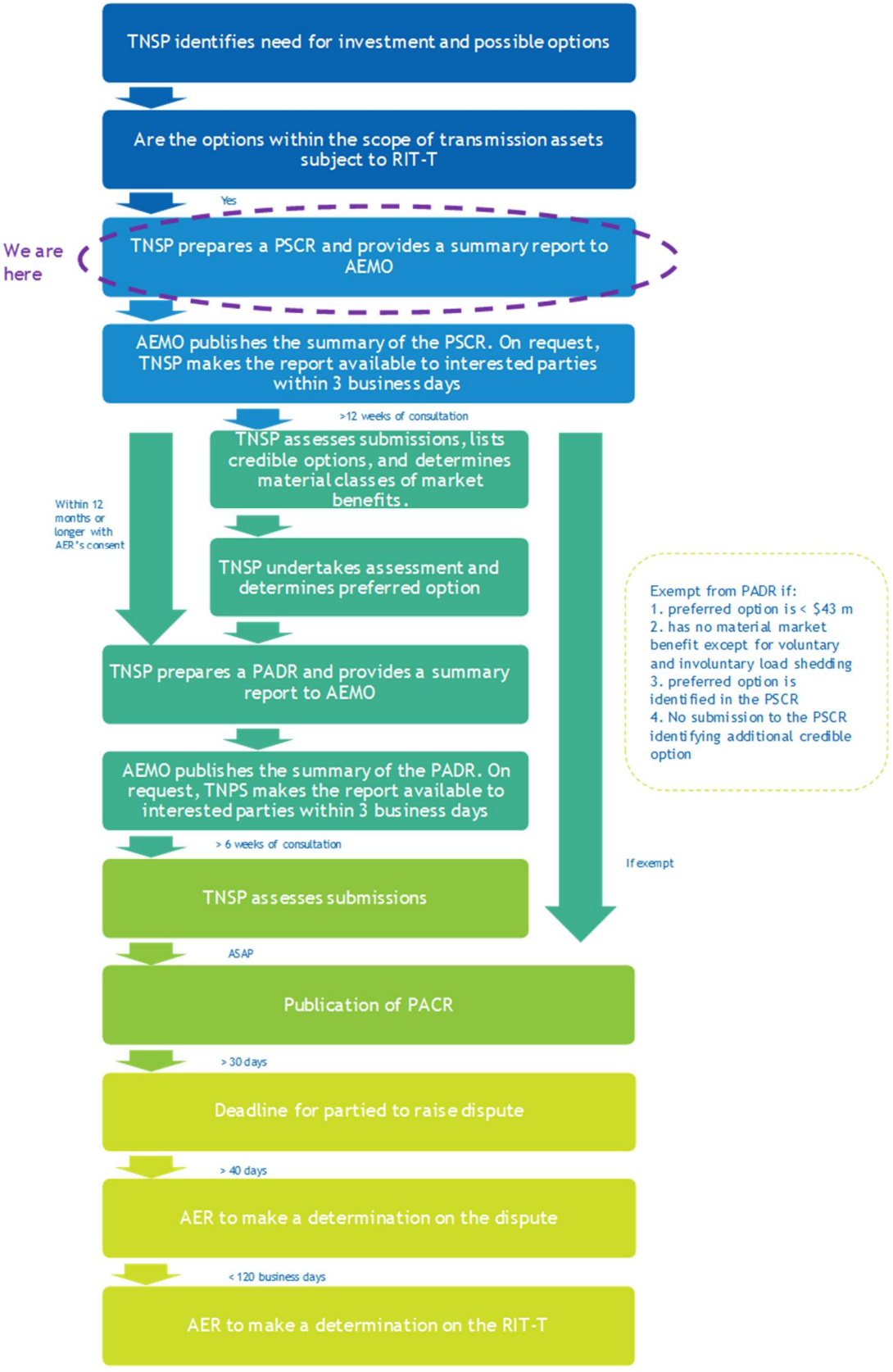

Figure 6 - RIT-T Process

Appendix B - Asset condition framework

AusNet Services uses an asset health index, on a scale of C1 to C5, to describe asset condition. The condition range is consistent across asset types and relates to the remaining service potential. The table below provides an explanation of the asset condition scores used.

Table 3 - Condition scores framework

Condition score	Likert scale	Condition description	Recommended action	Remaining service potential (%)
C1	Very Good	Initial service condition	No additional specific actions required, continue routine maintenance and condition monitoring	95
C2	Good	Better than normal for age		70
C3	Average	Normal condition for age		45
C4	Poor	Advanced deterioration	Remedial action or replacement within 2-10 years	25
C5	Very Poor	Extreme deterioration and approaching end of life	Remedial action or replacement within 1-5 years	15

Asset failure rates

AusNet Services uses the hazard function of a Weibull two-parameter distribution to estimate the probability of failure of an asset in a given year. The asset condition scores are used to establish a condition-based age which is used to calculate the asset failure rates using a two-parameter Weibull Hazard function (h(t)), as presented below.

$$h(t) = \beta . \frac{t^{\beta-1}}{\eta^{\beta}}$$

Equation 1: Weibull Hazard Function

where:

t = Condition-based age (in years)

η = Characteristic life (Eta)

β = Shape Parameter (Beta)

Hazard functions are defined for the major asset classes including power transformers, circuit breakers, and instrument transformers. All assets in the substation risk-cost model use a Beta (β) value of 3.5 to calculate the failure rates. The characteristic life represents that average asset age at which 63% of the asset class population is expected to have failed.

The condition-based age (t) depends on the specific asset's condition and characteristic life (η).